

CULTURE OF DELTA SMELT, *Hypomesus transpacificus*, AT DELTA SITE, IN SUPPORT OF ENVIRONMENTAL STUDIES AND RESTORATION

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I. Executive Summary

I. b. Project Description and Primary Biological/Ecological Objectives

The goal of the three-year project is to establish a functional culture system at a Delta site for the threatened delta smelt. Such a system, based on the annual procurement of 200-300 wild brood fish, will support ongoing environmental projects by providing all life stages of smelt for laboratory research. To achieve this goal, we will design and operate two small culture facilities, and optimize the methodologies of culture at these facilities, the State Water Project (SWP) Fish Facility and Fish Rearing Facility at the Federal Station in Byron. The main objectives of the project are: (1) to develop a reliable and technically feasible culture system encompassing all life stages of delta smelt; (2) to establish and characterize culture methods, environmental and technical parameters of culture system, and its production capabilities; (3) to initiate the supply of live material for testing in research laboratories, as well as preserved material and data that can be used as test-standards in ongoing projects of delta smelt habitat improvement.

I. c. Approach/Tasks/Schedule

The approach to culture system is based on our previous smelt projects at the SWP in Byron (Lindberg 1992, 1996) and at UC Davis (Mager et al. 1996), and collaboration with two laboratories at UC Davis (Fish Diseases, Dr. R. Hedrick and Fish Physiology, Dr. J. Cech). Delta smelt is an annual species maturing at the end of first year of life and spawning in spring. With relatively small egg yolk reserves, their newly emerged pelagic larvae start exogenous feeding on the fifth day after hatching. However, the duration of the larval stage to metamorphosis is extended for almost 3 months necessitating utilization of cultured and wild zooplankton for feeding larvae in culture. Our culture program will follow, with modifications, five basic steps: the procurement of wild juveniles, rearing them to spawning in flow-through tanks, hatching embryos in jars, rearing larvae to post-larval stage on cultured rotifers, and rearing post-larvae to full metamorphosis on natural and cultured zooplankton. Moving the entire life cycle culture system to site in the delta will provide advantages of improved spawning performance and availability of the natural zooplankton for rearing larvae to metamorphosis. The schedule and tasks of the project follow:

Year 1: a) installation of rearing system for the broodstock and culture unit for phytoplankton and rotifers at the Federal Station; b) rearing and spawning brood fish at both sites; c) optimization of larval culture (use of phytoplankton); d) rearing wild post-larval stages of delta smelt trapped at the Fish Collection Facilities, State and Federal.

Year 2: a) optimization of temperature and feeding regimes in larval culture; b) preliminary evaluation of larval survival, development, and growth.

Year 3: a) adjustments in production system based on the results of two years; b) evaluation of performance and production capabilities of culture system; c) summary evaluation of system design, culture protocols, and methodologies.

We will supply research laboratories and agencies with delta smelt of different life stages. Our target parameters for the culture system utilizing 250 brood fish (with minimum 100 females) are

35,000 fertilized eggs, 28,000 late-stage embryos or newly emerged larvae, and 10,000 juveniles at metamorphosis. The production system is expected to be compact but labor-intensive. The culture system can be used as a prototype for other species with pelagic larvae, such as the longfin smelt, american shad, and striped bass.

I. d. Justification for Project and Funding by CALFED

The delta smelt population and its unique upper estuary habitat are affected by a variety of environmental changes in ecosystem. There are ongoing projects supported by CALFED on habitat restoration and improvement in the Delta. Current supply of live delta smelt for the laboratory studies is scarce, unpredictable, and limited to adult/subadult life stages whereas the major impact may occur on early life stages. The proposed project will support ongoing studies on fish screen design, environmental physiology, eco-toxicology, and habitat improvement by providing smelt embryos, larvae, juveniles, and adults for laboratory testing. Additionally, preserved specimens and development growth-charts can be used as the standard for the evaluation of fish performance in the wild, and restored habitats.

I. e. Budget Costs

Project annual cost (includes 10% indirect cost) is \$194,870 for the year 1, \$195,537 for the year 2, and \$202,369 for the year 3. The major part of the budget supports three key personnel who will be working full-time at delta smelt culture facility. Their previous experience and technical skill are important for culture of delta smelt.

I. f. Applicant Qualifications

Dr. Serge Doroshov has research experience and expertise in developmental biology and hatchery technology of cultured fish, including sturgeon, striped bass, catfish, trout, and marine species. He and his graduate student, Dr. Randy Mager, have developed prototype culture-system for delta smelt at UC Davis and characterized sexual maturation, gametogenesis, and early development in this species. Dr. Joan Lindberg conducted her graduate studies on salmon metamorphosis and feeding behavior in sturgeon larvae. She led an independent project on delta smelt culture at SWP facilities in Byron before joining the university team. Joel Van Eenennaam has vast experience in breeding and culture of various fish species; he gained national reputation as one of the best aquacultural researchers. Brent Bridges conducted his M.S. project on larval nutrition and has excellent expertise in algal-rotifer production for larval culture, including 2 years experience with delta smelt. Jennie Kulczyk has completed a BS Degree in Biology and has developed experience in spawning, and rearing of larval and juvenile smelt at the SWP site.

I. g. Monitoring and Data Evaluation

Some of material of this project can be used as the standards for bio-monitoring program. For example, developmental charts for delta smelt can be used in the analysis of captured embryos, larvae, and post-larvae of smelt in different locations, to examine larval dispersal, growth and development in wild population.

I. h. Local Support/Coordination with other Programs/ Compatibility with CALFED objectives

The location of this project on site in the Delta is expected to enhance collaboration between State and Federal Agencies and university researchers. We will collaborate with the several laboratories and researchers at UC Davis.